

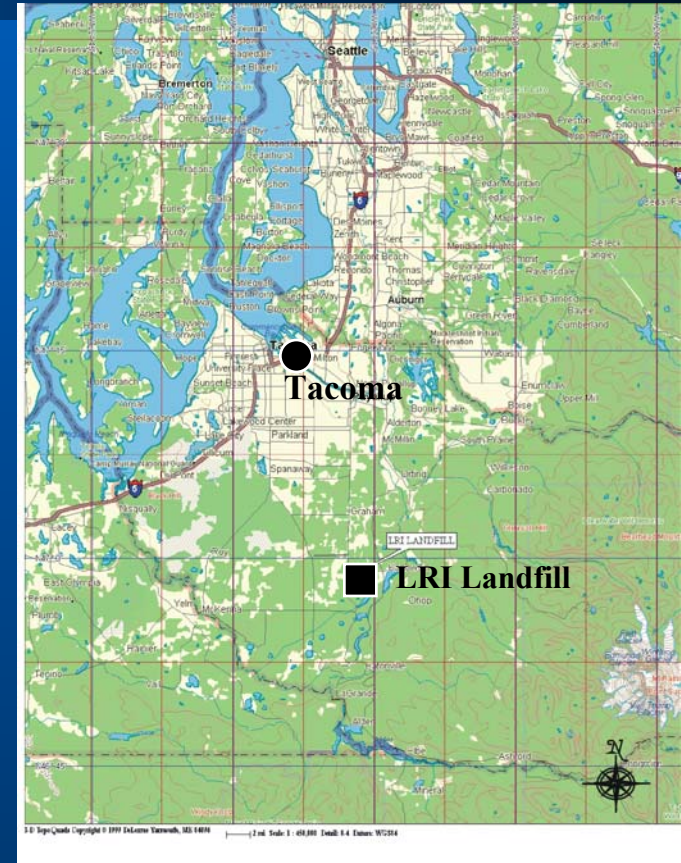
Design and Construction of an Inward Gradient Landfill

The LRI Landfill, Graham, Washington

Kevin Lakey, RG, PE
Kleinfelder, Inc.

Site Selection Process (started in 1986)

- Sized for Minimum 20-Year Life
- Main Transportation Route Access
- Outside of Original Sole Source Aquifer Petition Area
- Glacial Till Soil for Aquifer Protection



Site Features

Flat Topography, Wetland Areas,
Two Seasonal Streams



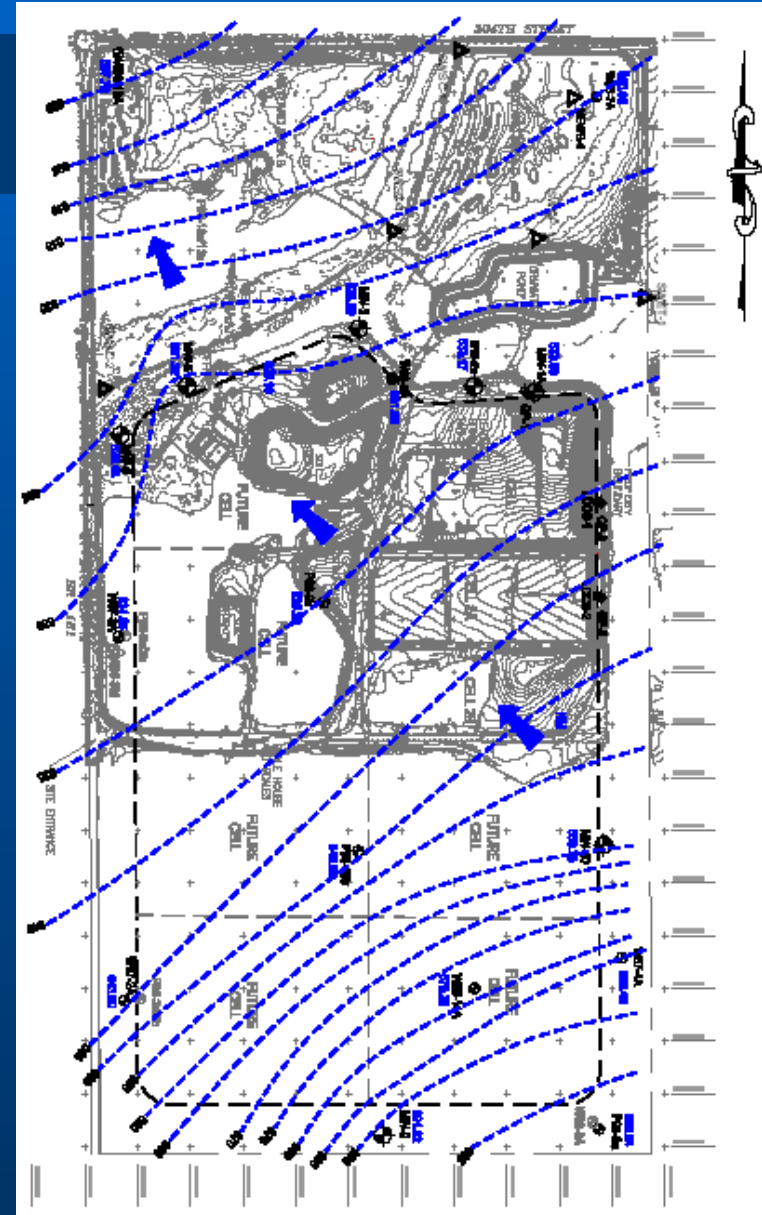
Site Characterization

- Drilling - 26 borings
- Test Pitting - 35 test pits
- Soil Testing - grain size & permeability
- Aquifer Testing - hydraulic conductivity & water quality
- Geophysics - 44 surface resistivity soundings

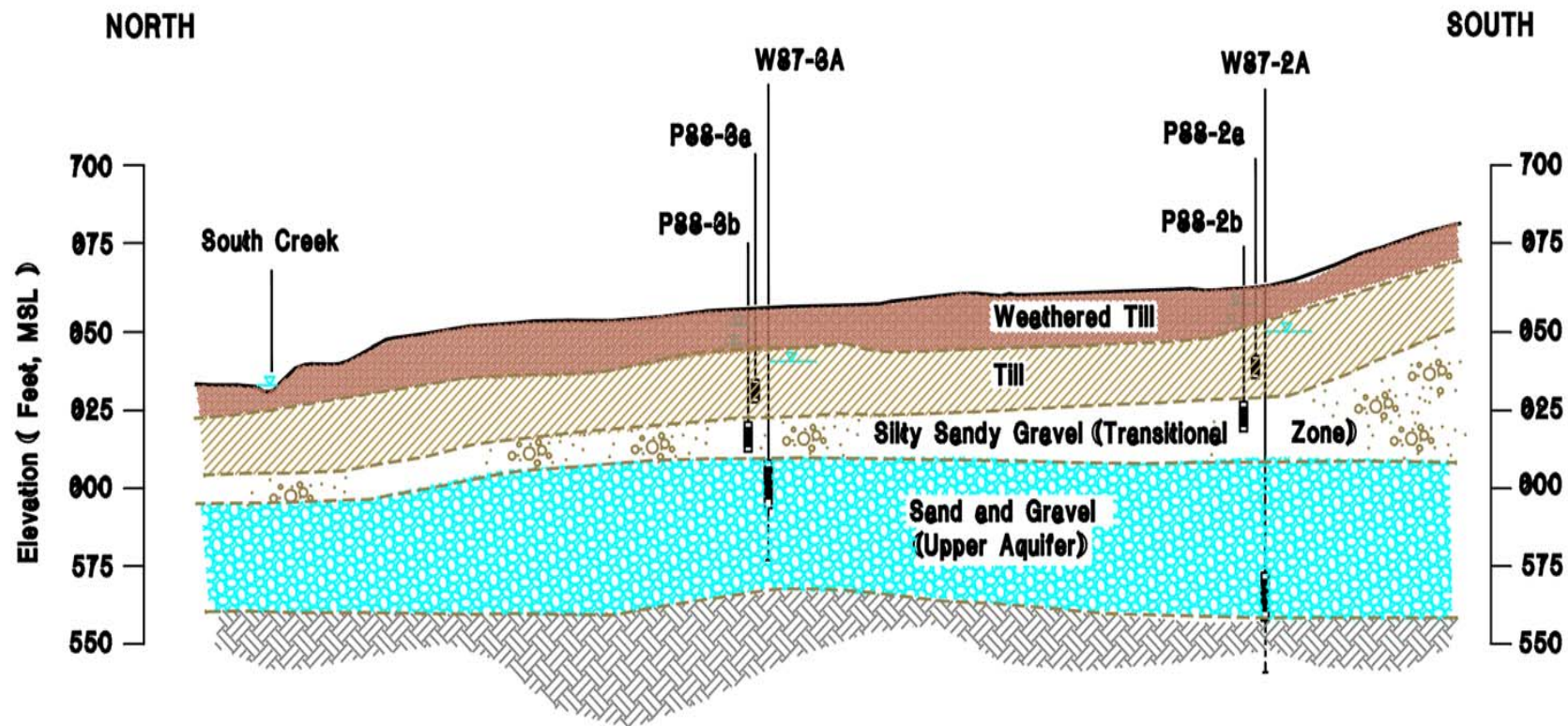


Hydrogeology

- 40 to 50 feet of Glacial Till
- Perched Water (on top of the till)
- Confined Uppermost Aquifer (beneath the till)
- Several Deeper Aquifer Systems



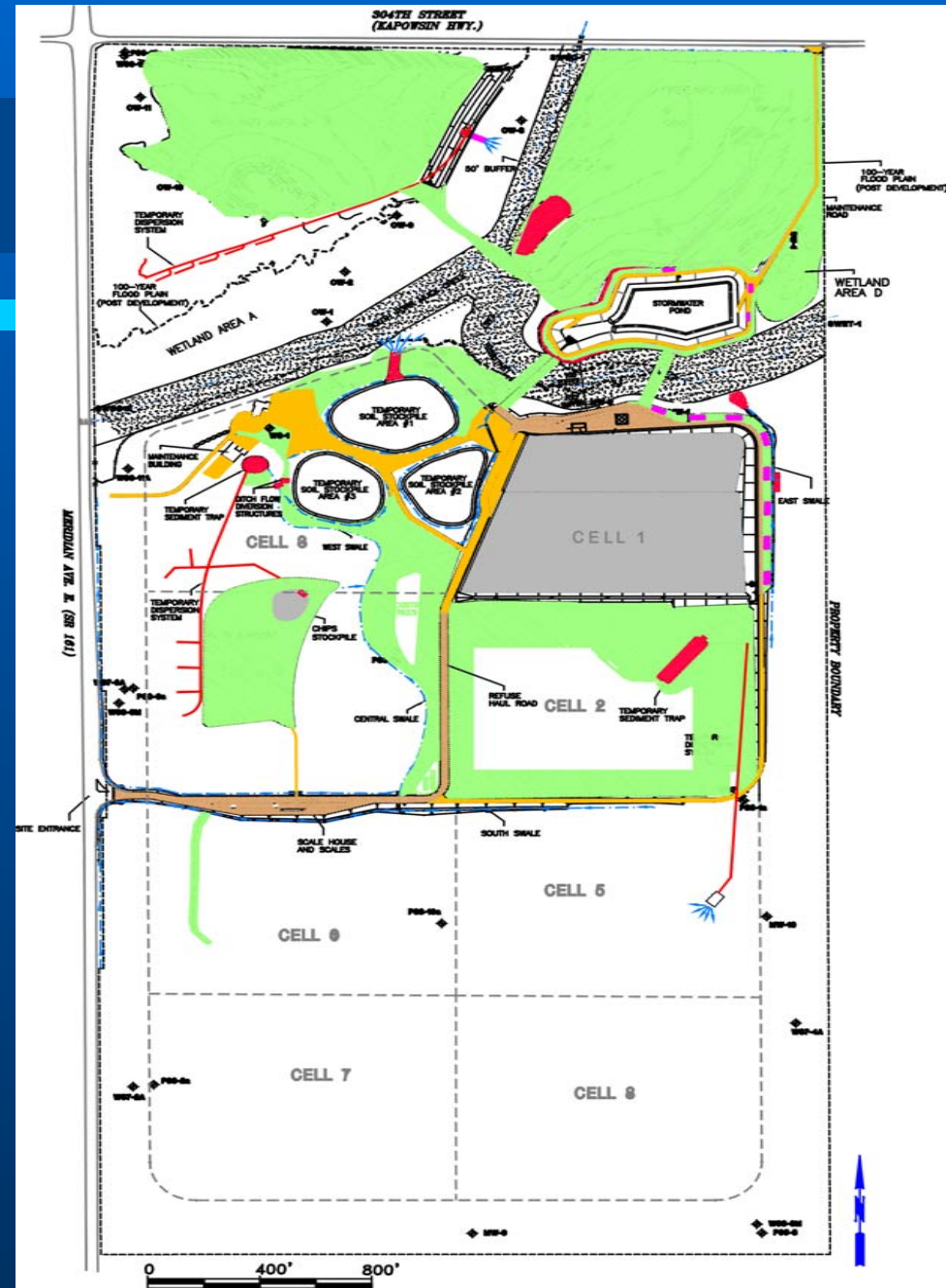
GEOLOGIC CROSS-SECTION



0 250 500
SCALE (feet)
Vertical Exaggeration = 10x

Site Layout

- 168 Acre “Footprint”
- 8 Contiguous “Cells”
- Perimeter Berm
- Scales
- Storm Water System
- Wetland Biofiltration
- Leachate Storage



Landfill Design

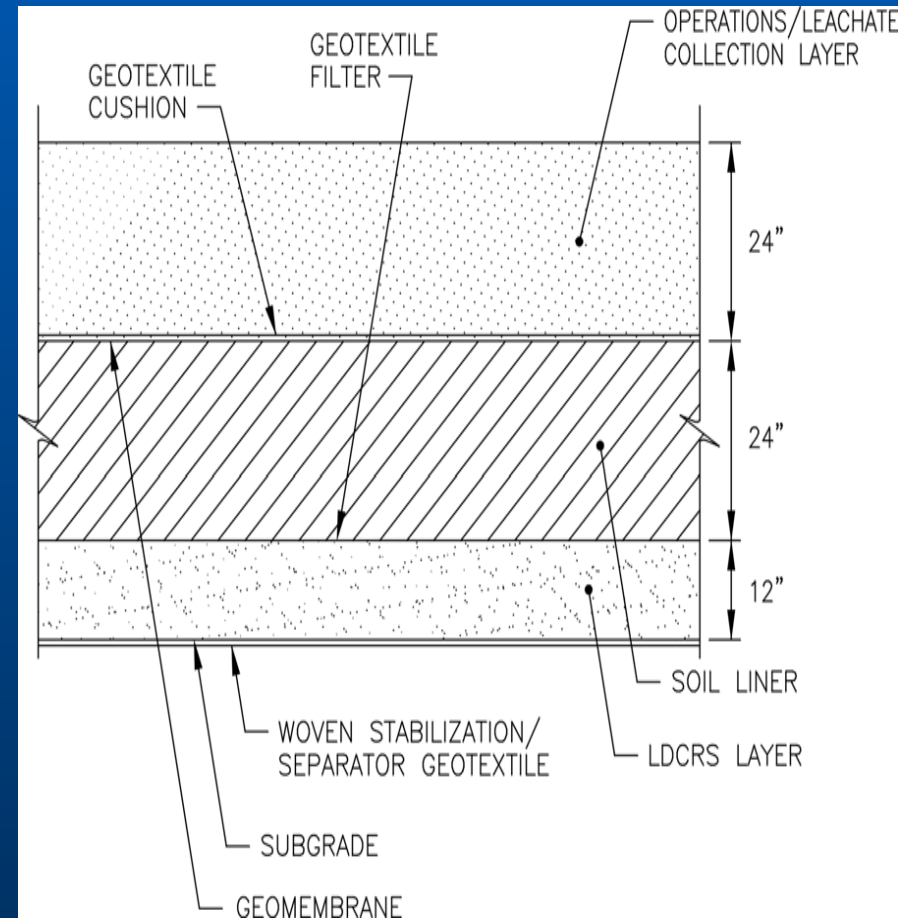
- Leak Detection / Collection System
- Composite Liner
- Leachate Collection
- Landfill Gas Collection
- Cover “Cap”
- Surface Water Controls

Leak Detection/Collection System

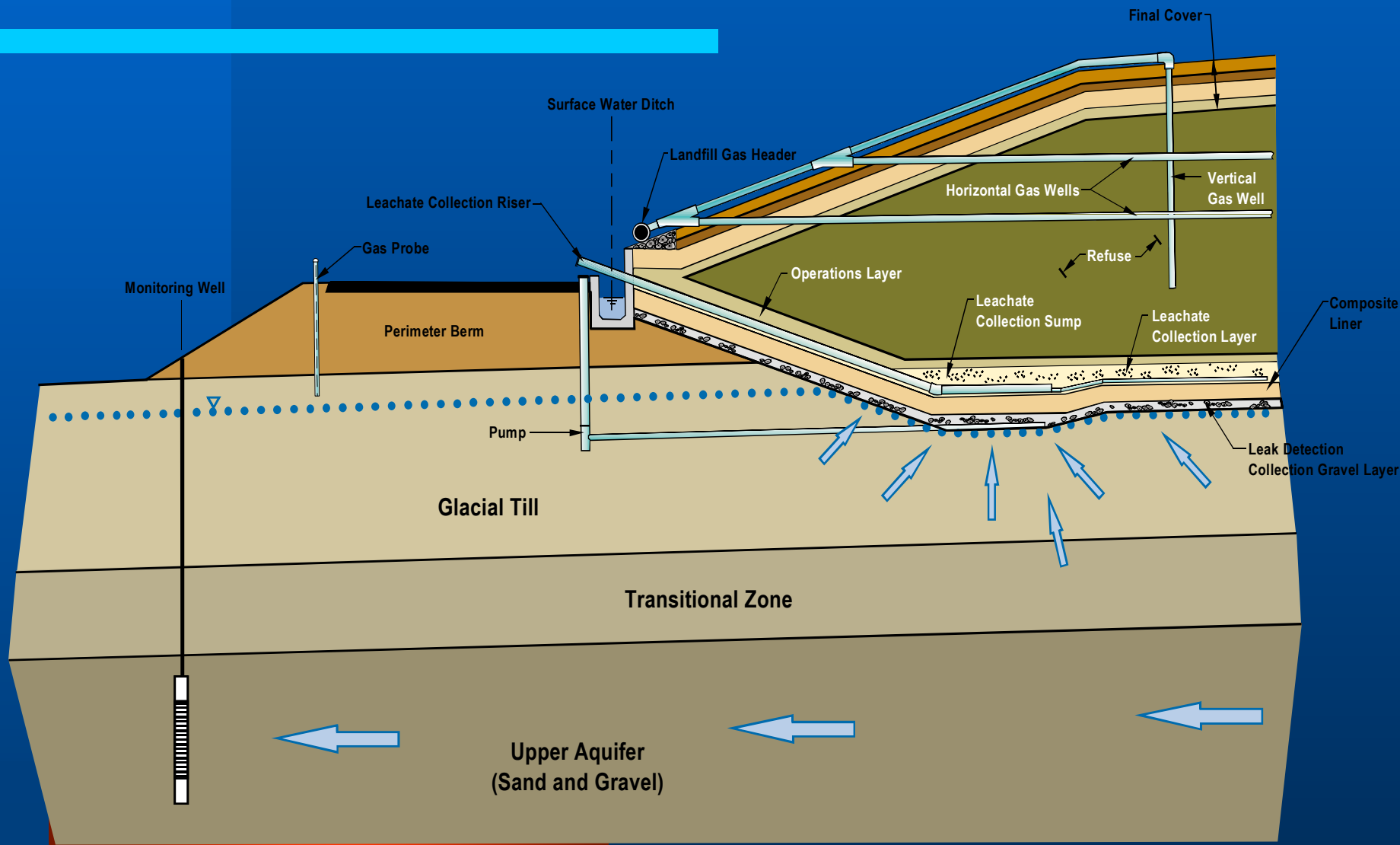
- Bottom Grades are Located Below the Potentiometric Surface
- System Design - Estimate Inflow Seepage
- High Permeability Gravel “Dewatering” Layer
- Geotextile Filters Above and Below the Gravel
- Float-activated Pumping Dewateres the System

Liner System

- Leak Detection Layer
- Composite Liner
 - two feet of low permeability clay
 - flexible membrane liner of 60 mil HDPE
- Geotextile Cushion
- Leachate Collection Layer



Landfill Cross Section



Landfill Construction

- Project Manual Preparation
 - Plans
 - Specifications
 - Construction Quality Assurance (CQA) Requirements
- Agency Review & Approval
- Obtain Contractor Bids

CQA Monitoring



- Third Party Review
- Progress Documentation / Reporting
- Liaison with Regulators
- Liner Test Pad Construction
- Confirm Subgrade Condition, Depths and Grades
- Soils Testing — aggregate testing, clay permeability
- Geosynthetics Testing — fabrics, GCL, HDPE
- Leak Testing (electro-resistivity survey)



Subgrade Excavation



Glacial Till



Trench Excavations
for Clay Plugs



Clay Plug Construction





Sump and Piping for Leak Detection System



Test Pad Construction





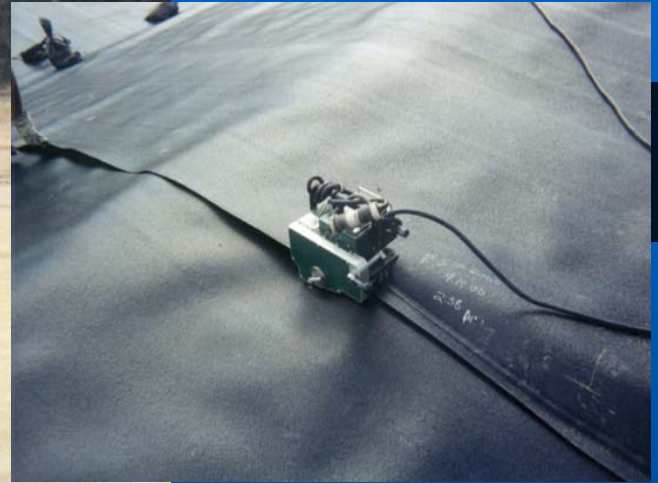
Leak Detection Layer





Clay Liner





HDPE Geomembrane



Leachate Collection Layer



Monitoring Requirements

- Leak Detection System
 - daily for volume pumped and conductivity
 - quarterly for Appendix I and II parameters
- Groundwater Monitoring Wells
 - quarterly for Appendix I and II parameters
- Surface Water — weekly, monthly, quarterly and annual
- Landfill Gas — monthly
- Over 20 Permits Apply to this Site!

Leachate Indicator Parameters for Leak Detection System Monitoring

Primary Indicators

- ammonia
- acetone
- 2-butanone

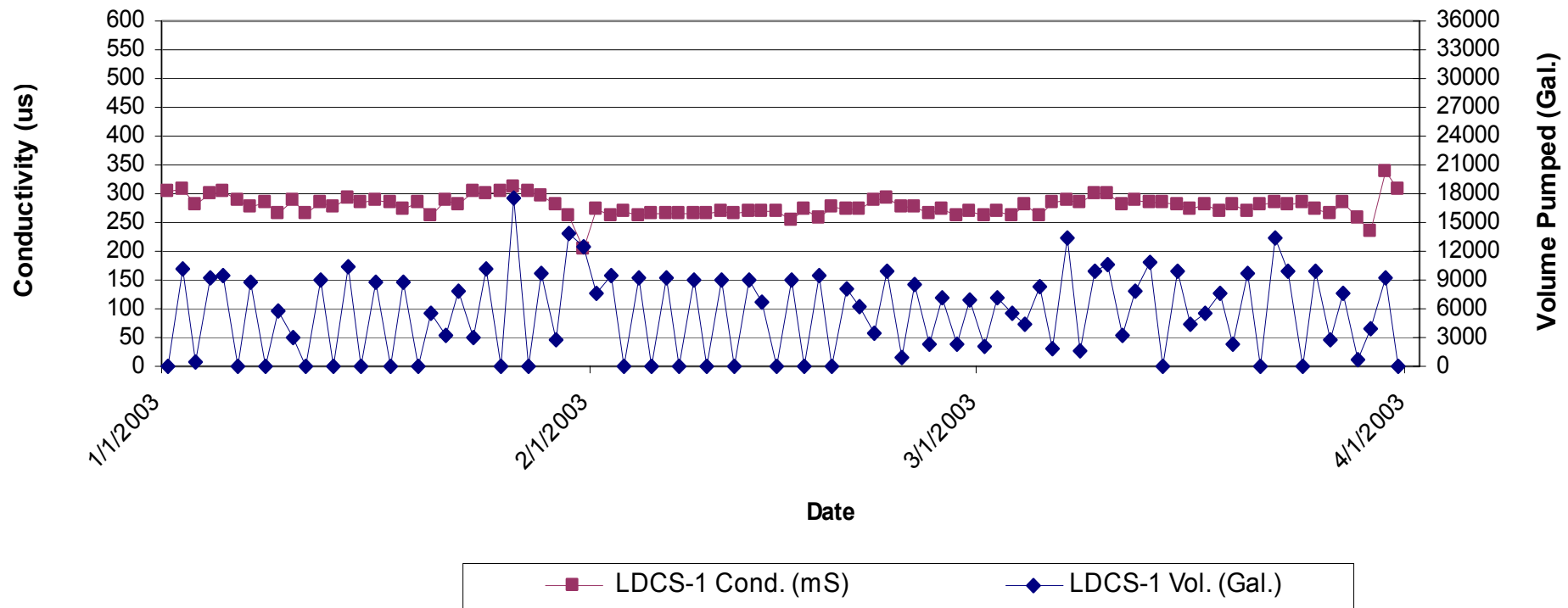
Secondary Indicators

- BOD (biological oxygen demand)
- COD (chemical oxygen demand)
- TOC (total organic carbon)

LDCS-1 Daily Conductivity vs Daily Volume Pumped

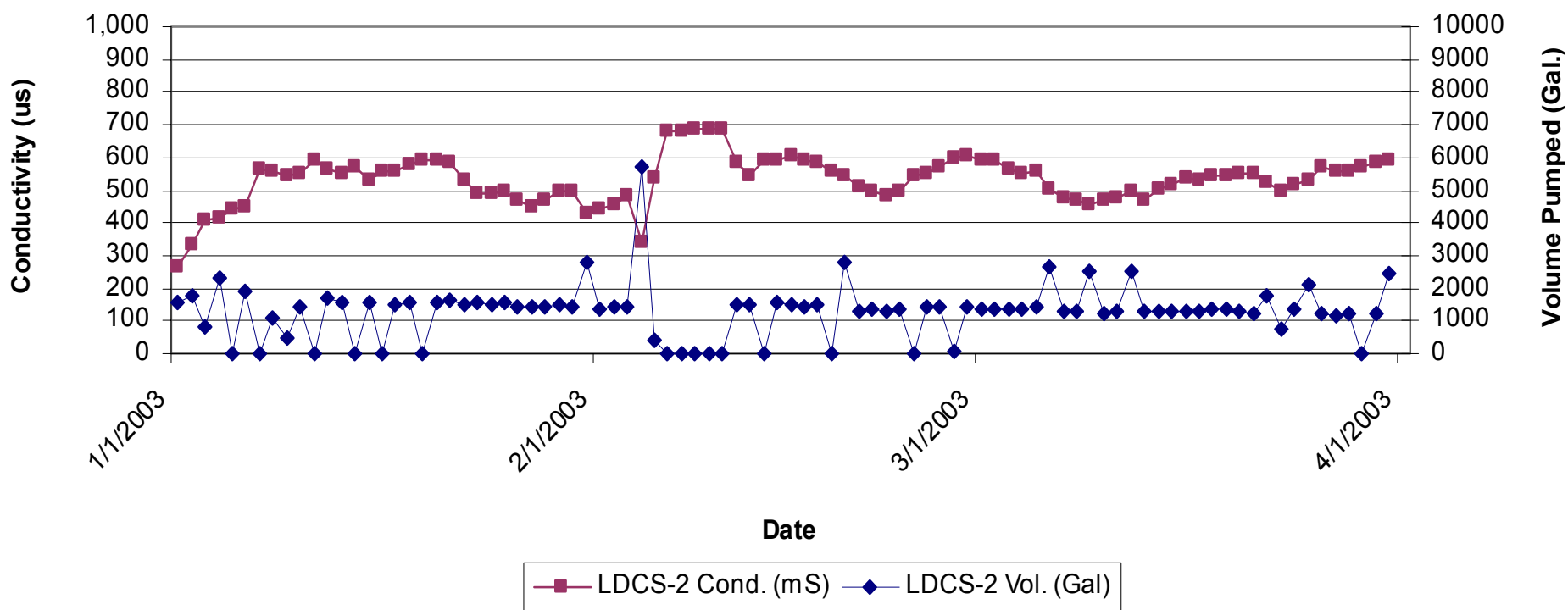
2003

LRI Landfill, Pierce County, Washington



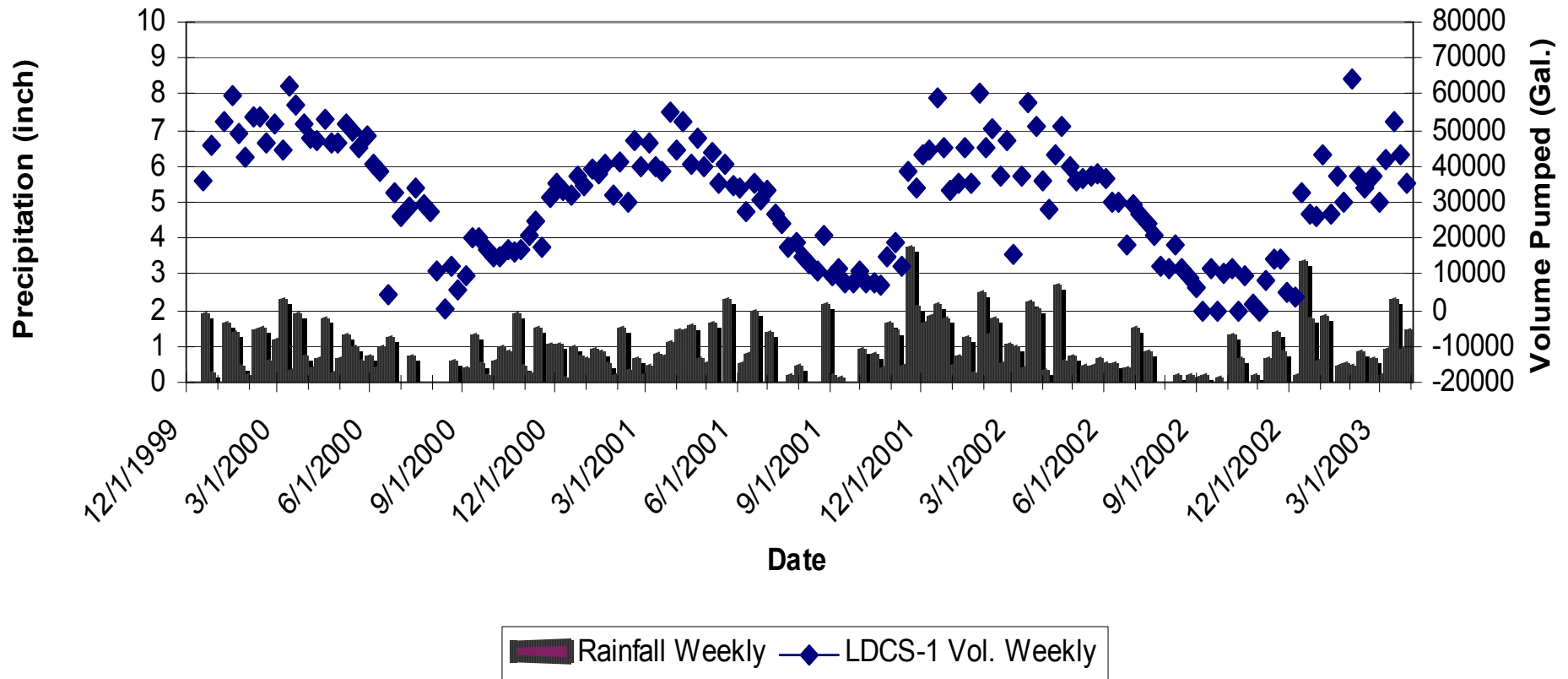
LDCS-2A Daily Conductivity vs Daily Volume Pumped 2003

LRI Landfill, Pierce County, Washington



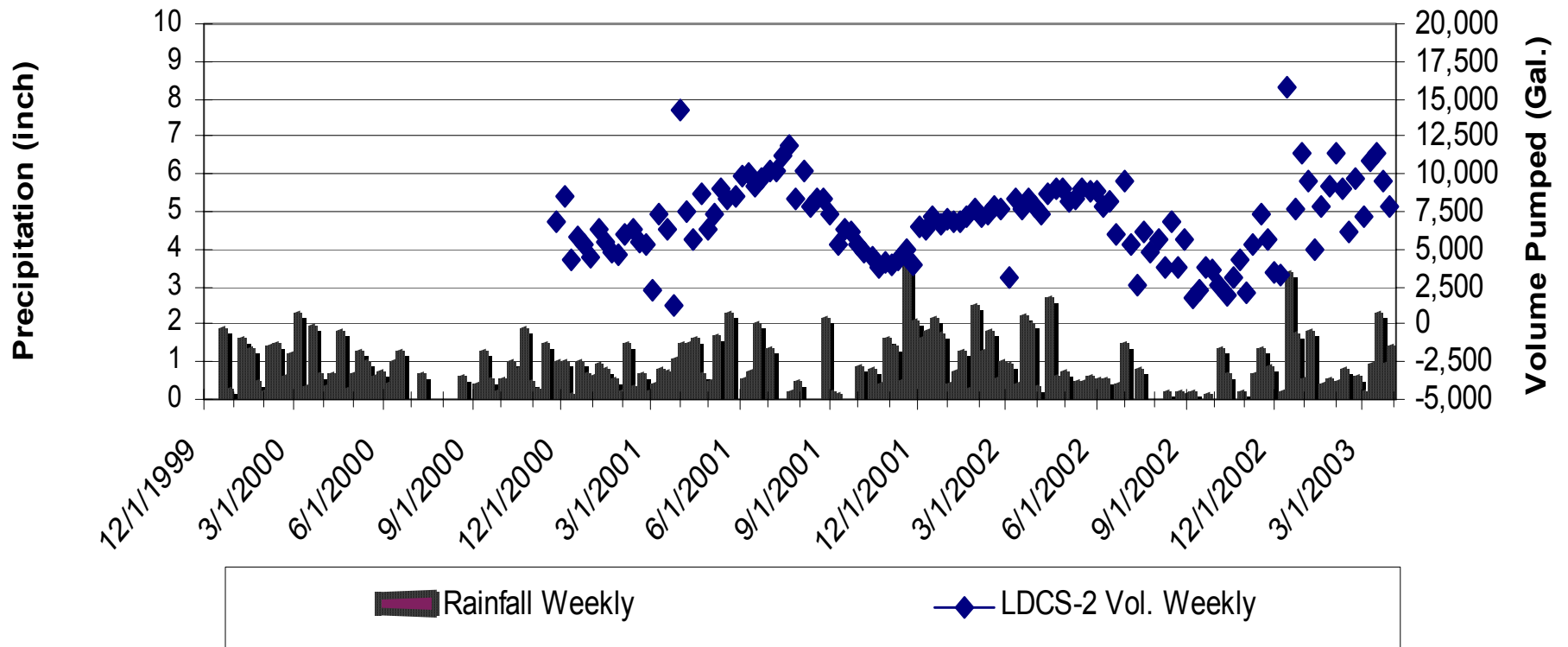
LDCS-1 Weekly Volume Pumped vs Precipitation

LRI Landfill, Pierce County, WA



LDCS-2A Weekly Volume Pumped vs Precipitation

LRI Landfill, Pierce County, WA



Protection of the Sole Source Aquifer

The unique combination of engineered containment, naturally occurring very low permeability glacial till, and upward groundwater flow from the confined aquifer into the leak detection system provide a state-of-the-art waste disposal facility that is protective of the regions groundwater.

Acknowledgements

Andy Comstock

Environmental Health Specialist

Tacoma-Pierce County Health Department

Cris Matthews

Hydrogeologist

Washington Department of Ecology

Thank You

